Translation from German

FEDERAL REPUBLIC OF GERMANY

GERMAN PATENT AND TRADEMARK OFFICE

12. **PATENT SPECIFICATION**

11. **DE 199 22 128 C1**

51. Int. Cl.7:
H 03 K 17/567
H 03 K 17/689
H 03 K 17/90
H 03 K 17/082

21. Case No.: 199 22 128.6-31
22. Application date: May 12, 1999
43. Date application published:
45. Date patent grant published: January 25, 2001

Opposition may be filed within 3 months after publication of the patent grant

71. Applicant:

Siemens AG, 80333 Munich, DE

72. Inventor:

Munz, Dieter, Dipl.-Ing. (FH), 91315 Höchstadt, DE;
Günther, Harald, Dipl.-Ing., 90537 Feucht, DE;
Staudt, Michael, Dipl.-Ing. (FH), 90469 Nürnberg, DE;

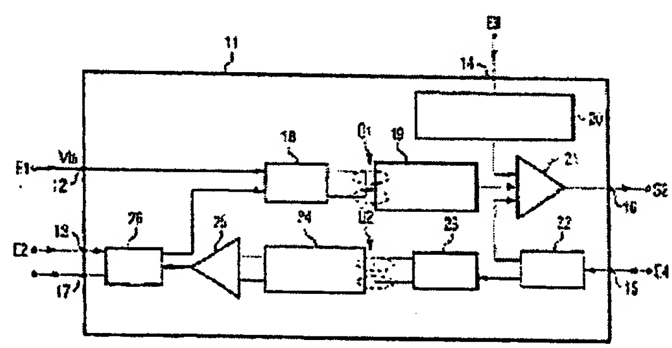
56. Prior art publications taken into consideration for the determination of patentability:

DE 43 16 694 C1
DE 197 18 420 A1
DE-OS 20 02 693
DE-OS 15 62 171
CH 6 84 140 A5
EP 06 80 146 A2

RUEDI, Heinz: Schnittstelle zwischen Steuerelektronik und Leistungsteil: Schlüsselkomponente IGBT-Treiber *[Interface between electronic control system and power supply: Key components of IGBT drivers]*, in: Components, 34, 1996, Vol. 2, pp. 46-49.

54. Integrated circuit for generating a drive signal for an Isolated Gate Bipolar Transistor (IGBT)

57. The invention relates to an integrated circuit for generating a drive signal for an insulated gate bipolar transistor (IGBT). The above mentioned circuit has an input terminal for a control signal generated by means of a micro-controller and includes a control signal path taken from the input terminal to a control signal processing unit. The control signal path also contains a magneto-sensitive device for electrical isolation.



Description

Integrated circuit for generating a drive signal for an Isolated Gate Bipolar Transistor (IGBT)

This invention relates to an integrated circuit for the generation of a drive signal for an IGBT (isolated gate bipolar transistor).

Direct-current or alternating-current motors can be driven using a micro-controller, for example, an arrangement which requires the use of electrically isolated driver components. The drive signal generated by means of the respective driver component is fed to the gate of a power breaker which can be realized in the form of an IGBT, whereby the gate of the IGBT is electrically isolated from the micro-controller, see also EP 0 680 146 A2.

The prior art discloses the realization of this electrical isolation by a hybrid or sandwich construction of an optical coupler, in which case LEDs and corresponding optical receivers are used.

DE-197 18 420 A1 discloses an integrated data transmission circuit with electrical isolation between the input and output circuits. Binary signals are fed to this circuit on the input side which are transmitted by the use of a magneto-sensitive coupling element which is located inside the integrated data transmission circuit, and are made available at the output of the integrated data transmission circuit in the form of binary output signals.

The object of the invention is to indicate an integrated circuit for the generation of a drive signal for an IGBT, the construction of which is simplified.

The invention teaches that this object is accomplished by an integrated circuit with the features disclosed in Claim 1. Advantageous configurations and developments of the invention are described in the subclaims.

The advantages of the invention, in addition to its simplified construction, include the fact that integrated circuits as claimed by the invention can be produced more economically and that its switching times are faster. It is also relatively easy to

implement additional functions, such as, for example, diagnostic functions or monitoring functions, in an integrated circuit of the type claimed by the invention.

Additional advantageous characteristics of the invention are explained in greater detail below with reference to the exemplary embodiments that are illustrated in the accompanying figures, in which:

Figure 1 illustrates a first exemplary embodiment of the invention and

Figure 2 illustrates a second exemplary embodiment of the invention.

Figure 1 shows a first exemplary embodiment of an integrated driver component which makes available at its output 4 a driver signal V_{out} for an IGBT to control brushless direct-current and alternating-current motors.

The driver component which is in the form of an integrated circuit 1 has connections 2, 3, 4, 5. The connection 2 is an input connection to which an input signal V_{in} provided to an input E is fed, which is a signal generated in a micro-controller and is to be converted by means of the driver component into a suitable V_{out} suitable for driving the IGBT. The connection 3 is an input connection for a power supply voltage V_{cc} derived from a power source. The connection 4 is an output connection for the above mentioned driver signal V_{out}. The connection 5 is a connection for a reference voltage V_{ee}, preferably a ground connection. The input signal V_{in} generated by the micro-controller is first fed inside the integrated circuit 1 to a transmitter logic circuit 6. The purpose of this logic circuit is to convert the above mentioned input signal V_{in} into a current signal which is particularly well suited for a magneto-sensitive transmission. For this purpose, a signal inversion, for example, can be performed in the transmitter logic circuit 6.

Connected to the transmitter logic circuit 6 is a transmitter Ü which is provided for a magneto-sensitive transmission of the output signal of the transmitter logic circuit. This magneto-sensitive transmission is performed to achieve an electrical isolation between the micro-controller side and the motor side of the circuit. The necessity for this electrical isolation results from the fact that the micro-controller side and the motor side are connected to different reference potentials.

The transmitter Ü has, on the input side, a conductor loop via which the output signal 6, which is present in digital form, is guided to the transmitter logic circuit 6. By

means of this digital signal, a magnetic field that varies as a function of the digital signal is generated in the area surrounding the conductor loop, as indicated by the broken lines in Figure 1. This varying magnetic field is detected by a magnetic field detector or a magneto-sensitive receiver 7 which is isolated from the conductor loop by an isolator, but is located in the vicinity of the above mentioned magnetic field.

The magnetic field detector of the device for the electrical isolation can be realized in the form of a Hall element. The above mentioned magnetic field detector can also be an AMR (anisotropic magnetic resistance) sensor which reacts with a varying resistance to a varying magnetic field. AMR sensors of this type have a permalloy layer.

To enhance the sensitivity of the magnetic field detector, the detector can also be realized in the form of a GMR (giant magnetic resistance) sensor. GMR sensors of this type have a combination of three layers, two of which are made of magnetically soft material and one of which is made of magnetically hard material.

A further improvement in the sensitivity of the magnetic field detector can be achieved by realizing the detector in the form of a TMR (tunneling magnetic resistance) sensor. In a sensor of this type, the material made of magnetically hard material is replaced by an isolating layer.

The signal detected by the magneto-sensitive receiver 7 is fed in the form of a digital signal electrically isolated from the input side to a control block 8. This control block is also connected with the connection 3 for the power supply V_{cc} and to the connection 5 for the reference voltage V_{ee}. On the output side, the control block 8 makes a driver signal available for the gate of an IGBT 9.

In the exemplary embodiment illustrated in Figure 1, in an integrated circuit provided in the form of a driver component for an IGBT, in addition to a control block 8, there is also a magneto-sensitive transmitter for the electrical isolation between the micro-controller side and the motor side. This arrangement simplifies the circuit construction, makes possible a more economical production of IGBT driver circuits, allows faster switching times and a simplified integration of additional diagnostic monitoring and logic circuit components.

Figure 2 illustrates a second exemplary embodiment of an integrated driver component which makes available at its output 16 a driver signal S2 for the basis of an

IGBT which is not shown but is located outside the integrated circuit 11. This external IGBT drives a connected motor.

The driver component present in the form of an integrated circuit 11 has connections 12, 13, 14, 15, 16, 17. The connection 12 is an input connection to which is fed an input signal V_{in} provided at an input E1, which is a signal generated in a micro-controller and is to be converted by means of the driver component into a driver signal for an IGBT. The connection 13 is an input connection for a reset signal which is generated by means of a microcontroller and which is available at the input E2. The connection 14 is an input connection for a signal from a motor-side voltage monitor which is fed to the illustrated device by means of the input E3. By means of the input connection 15, an input signal derived from the collector of the external IGBT is fed to the integrated circuit 11 and is available at the input E4. The connection 16 is an output connection of the integrated circuit 11 at which the above mentioned driver signal S2 for the external IGBT is output. The connection 17 is an output connection for a fault signal which is fed from there out of the micro-controller.

The input signal V_{in} generated by the micro-controller is first fed inside the integrated circuit 11 to a transmitter logic circuit 18. The task of this logic component is to convert the above mentioned input signal V_{in} into a current signal which is particularly well suited for a magneto-sensitive transmission. For this purpose, a signal inversion, for example, can be performed in the transmitter logic circuit.

Connected to the transmitter logic circuit 18 is a transmitter Ü1 which is provided for a magneto-sensitive transmission of the output signal of the transmitter logic circuit. This magneto-sensitive transmission is performed to achieve an electrical isolation between the micro-controller side and the motor side of the circuit. The necessity for this electrical isolation results from the fact that the micro-controller side and the motor side are connected to different reference potentials.

The transmitter Ü1 is realized just like the transmitter Ü described above in connection with Figure 1.

The signal detected by the magneto-sensitive receiver 19 is fed in the form of a digital signal electrically isolated from the input side to an input of a driver amplifier 21. An output signal from the circuit block 20 is fed to another input of this driver amplifier

21, which output signal monitors the motor-side voltage and can optionally perform an immediate shutdown of the motor. The driver amplifier 21 is also connected on the input side with a fault detector 22 to which the output signal derived from the collector of the external IGBT and present at the input 15 is fed. The fault detector 22 monitors the above mentioned input signal and in the event of an overcurrent, for example, ensures a smooth deactuation of the motor.

At the output of the driver amplifier 21, the driver signal S2 for the external IGBT is made available and is forwarded to it via the output connection 16 of the integrated circuit 11.

The fault detector 22 is also connected on the output side with a transmitter logic circuit 23. The purpose of this arrangement is to convert the output signal from the fault detector 22 that indicates the existence of a fault into a current signal which is particularly well suited for a magneto-sensitive transmission.

Connected to the transmitter logic circuit 23 is a transmitter Ü2 which is provided for a magneto-sensitive transmission of the output signal of the transmitter logic circuit 23. This magneto-sensitive transmission is performed to achieve an electrical isolation between the motor side, on which the signal applied to the input 15 is generated, and the micro-controller side on which the signal made available at the output 17 is made available.

The transmitter Ü2 is realized just like the transmitter Ü described above in connection with Figure 1.

The signal detected by the magneto-sensitive receiver 24 is amplified in the form of a signal that is electrically isolated from the motor side in an amplifier 25 and is fed via a fault signal buffer 26 and the output 17 of the integrated circuit 11 to the external micro-controller.

The signal present at the input 13 of the integrated circuit is a reset signal and is provided for the micro-controller controlled resetting of the fault signal buffer memory 26.

An additional output of the fault signal buffer memory is connected with an input of the transmitter logic circuit 18, so that when a fault is present, it can also act on the driver signal of the IGBT and thereby prevent a repeated starting of the motor.

In the exemplary embodiment illustrated in Figure 2, an integrated circuit provided as a driver component for a motor includes, along with a driver amplifier 21, a fault detector for micro-controller side faults and a fault detector for motor-side faults, two magneto-sensitive transmitters Ü1 and Ü2 for the electrical isolation between the micro-controller side and the motor side. This arrangement simplifies the circuit design, makes possible economical production of motor driver circuits, faster switching times and - as is apparent from the exemplary embodiment illustrated - an easy integration of additional diagnostic, monitoring and logic circuit components.

Integrated circuits as claimed by the invention can be used to drive both direct-current and alternating-current motors.

Claims

1. Integrated circuit to generate a driver signal for an IGBT with an input connection for a control signal generated by means of a micro-controller and a control signal path that leads from the input connection to a control signal processing unit, **characterized by the fact** that the integrated circuit (1, 11) has, in the control signal path, a magneto-sensitive device (Ü, Ü1) for electrical isolation, and that the integrated circuit has a fault detector (22) to detect motor-side faults, whereby the fault detector is connected on the output side with a second magneto-sensitive device (Ü2) for electrical isolation, which is connected on the output side via a fault signal buffer memory (26) with an output connection (17) of the integrated circuit, and the fault signal buffer memory (26) is connected on the output side with an input of a transmitter logic circuit (18) provided in the control signal path.

2. Integrated circuit as claimed in Claim 1, characterized by the fact that the transmitter logic circuit (18) is provided for electrical isolation between the input connection (2, 12) and the magneto-sensitive device (Ü, Ü1) for electrical isolation.

3. Integrated circuit as claimed in Claim 1 or 2, characterized by the fact that the magneto-sensitive device (Ü, Ü1) has a conductor loop on the input side and a magnetic field detector element (7, 19) on the output side.

4. Integrated circuit as claimed in Claim 3, characterized by the fact that the magnetic field detector is a Hall element.

5. Integrated circuit as claimed in Claim 3, characterized by the fact that the magnetic field detector element is an anisotropic magnetic resistance (AMR) component.

6. Integrated circuit as claimed in Claim 3, characterized by the fact that the magnetic field detector element is a giant magnetic resistance (GMR) component.

7. Integrated circuit as claimed in Claim 3, characterized by the fact that the magnetic field detector element is a tunneling magneto-sensitive *[Translator's Note: sic - should be tunneling magnetic resistance]* (TMR) component.

8. Integrated circuit as claimed in one of the Claims 1-7, characterized by the fact that it has an output connection (16) for a driver signal (S2) for an external IGBT.

9. Integrated circuit as claimed in Claim 8, characterized by the fact that it has an input connection (15) for a signal derived from the collector of an external IGBT.

10. Integrated circuit as claimed in one of the preceding claims, characterized by the fact that there is an amplifier (25) in the signal path of the fault signal between the second magneto-sensitive device (Ü2) for electrical isolation and the output connection (17).

11. Integrated circuit as claimed in one of the preceding claims, characterized by the fact that the fault signal buffer memory (26) is connected on the input side with an input connection (13) of the integrated circuit for a reset signal.

12. Integrated circuit as claimed in one of the preceding claims, characterized by the fact that it has a fault detector for the detection of micro-controller-side faults.

2 pages of drawings